

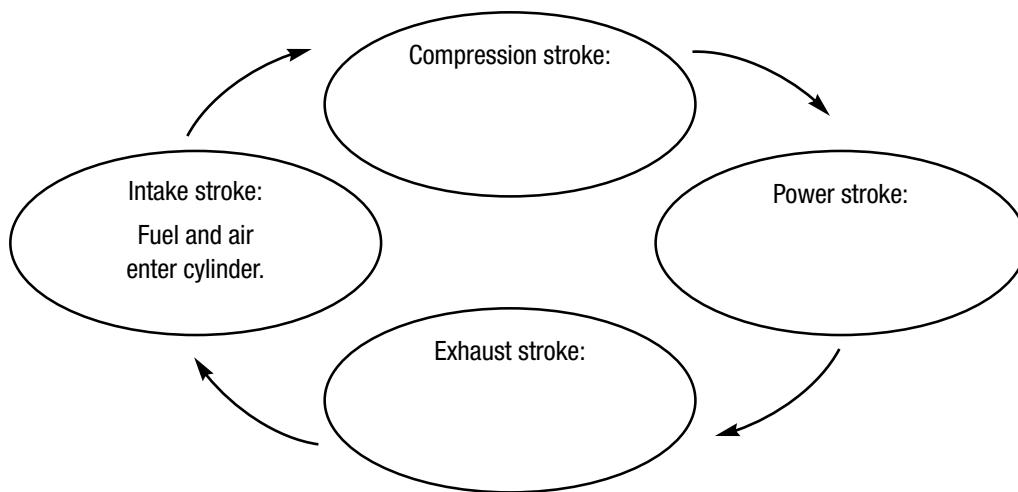
**Chapter 16 Thermal Energy and Heat****Section 16.3 Using Heat****(pages 486–492)**

*This section describes ways in which humans benefit from heat engines, heating systems, and cooling systems. It also discusses how each of these systems works.*

**Reading Strategy (page 486)**

**Sequencing** As you read, complete the cycle diagram to show the sequence of events in a gasoline engine. For more information on this Reading Strategy, see the **Reading and Study Skills** in the **Skills and Reference Handbook** at the end of your textbook.

**Sequence of Events in a Gasoline Engine**

**Heat Engines (pages 486–487)**

1. The two main types of heat engines are the \_\_\_\_\_ and the \_\_\_\_\_.
2. A steam engine is an external combustion engine because it burns fuel \_\_\_\_\_ the engine.
3. Who developed the first practical steam engine?
  - a. James Prescott Joule
  - b. Thomas Newcomen
  - c. James Watt
  - d. Benjamin Thompson
4. How is heat converted into work in a steam engine? \_\_\_\_\_  
\_\_\_\_\_
5. A heat engine used by most cars in which fuel burns inside the engine is called a(n) \_\_\_\_\_.
6. Each upward or downward motion of a piston in an internal combustion engine is called a(n) \_\_\_\_\_.

## Chapter 16 Thermal Energy and Heat

7. Is the following sentence true or false? In a typical car, the crankshaft produces a linear motion that turns the wheels.  
\_\_\_\_\_
8. Why is it important for an internal combustion engine to have a cooling system? \_\_\_\_\_  
\_\_\_\_\_
9. Is the following sentence true or false? Gasoline engines operate very efficiently in converting fuel energy to work.  
\_\_\_\_\_

### Heating Systems (pages 489–490)

10. What is a central heating system? \_\_\_\_\_  
\_\_\_\_\_
11. List four energy sources used for central heating systems.
  - a. \_\_\_\_\_ b. \_\_\_\_\_
  - c. \_\_\_\_\_ d. \_\_\_\_\_
12. Is the following sentence true or false? In most heating systems, conduction is used to distribute most of the thermal energy.  
\_\_\_\_\_

*Match each description with the heating system it describes.*

| Description  | Heating System   |
|--|--|
| _____ 13. Water heated by a boiler circulates through radiators in each room, transferring thermal energy. | a. hot-water heating<br>b. steam heating<br>c. electric baseboard heating<br>d. forced-air heating |
| _____ 14. Fans are used to circulate warm air through ducts to the rooms in a building.                    |  |
| _____ 15. A hot coil heats air by conduction and radiation.  |  |
| _____ 16. This system is often used in older buildings or to heat many buildings from a single location.   |  |

### Cooling Systems (pages 490–492)

17. Is the following sentence true or false? Most cooling systems, such as air conditioners and refrigerators, are heat pumps.  
\_\_\_\_\_
18. A fluid that vaporizes and condenses inside the tubing of a heat pump is called a(n) \_\_\_\_\_.
19. How does a heat pump reverse the normal flow of thermal energy? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_